# Growth and Survival of Some Microorganisms on Cotton Fabrics Treated with Extracts of Mesquite (*Prospuis juliflora*)

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## ABSTRACT

The present study investigated the effects of the aqueous extracts of mesquite on growth and survival of two bacteria. The results of the study showed that the aqueous extracts of the different plant parts of mesquite were highly effective in suppressing bacterial growth. However, the aqueous extracts were more effective against the gram-positive bacterium (*Staphylococcus aureus*) compared to the Gram-negative bacterium (E. *coli)*. Extracts of mesquite plant were also effective in decreasing the survival ability of the two tested bacteria on cotton fabrics, although the effects were more pronounced against the Gram-positive bacterium (*Staphylococcus aureus*).

**Key words:** Mesquite plant, aqueous extract, *E. coli*, *Staphylococcus aureus.*

## INTRODUCTION

Textiles and fibrous materials are usually subjected to various finishing techniques before being provided for their users, and to provide protection for the textiles from bio deterioration. Microbes are generally fall into three main categories, bacteria, fungi and algae, only the first two are applicable to textiles. However, the microbial persistence in fabrics may result in the dissimilation of the microorganisms in near environment (McNeil, 1964).

The transfer of pathogenic bacteria and other microorganisms among patients in hospitals is a growing concern (Elobeid, 1987 and Abdalla, 1998). One of the critical aspects of bacterial transmission from a person (patient or a health care worker) to the environment and then to another person is the ability of the microorganism to survive on various common hospital materials, such as fabrics (Neely and Maley, 2000). McNeil and Greentein (1961) had pointed out that the physical characteristics of the fibers themselves and probably, the surface electron charges on both fibers and the bacterial cell, may be

important in influencing the attachment of bacteria to the fabric surface. Lee *et al*. (1969) found that *Salmonella typhimurium* can remain viable and infectious, on different fabrics, for relatively long periods of time. They also added that contaminated fabrics might be a potential source of infection. However, garments of health care workers are considered an important aspect of the environment that can easily become contaminated (Johnson, 1977).

Fabrics treated with antimicrobial agents, are therefore, gaining popularity as a new promising area of research (Alex, *et al*., 2003). Treated fabrics are used as protective clothing in medical care centers, hotels, restaurants and food industry sectors. Both synthetic and natural antimicrobial agents are used for treatment (Lee *et al*., 1969). It was found that cotton fabrics with chitosan and fluoropolyemers exhibit durable antimicrobial activity even after laundering (Lee *et a.,l* 1999). Several studies have confirmed the effect of chitosan as an antimicrobial agent in fabrics (Kim *et al*., 1998 and Chung *et al*., 1998).

Infections caused by antibiotic-resistant Gram positive bacteria such penicillin-resistant *S. aureus* and vanoomycin-resistant antibiotics are a growing concern. As more bacteria become resistant to antibiotics, the success of using antibiotic treatments in fabrics decreases (Neely and Maley, 2000).

Plants extracts were found as alternative control agents against microorganisms since the beginning of the human civilization when people have used plants as medicines (Anna, 1993). The earliest uses of plant materials as antimicrobial agents are found in the Babylonian circa in 1770BC and in Egypt since 1550 BC (Anna, 1993). Acacia and many other plant types are widely used for that purpose.

Mesquite (*P. juliflora*), is zerophytc leguminous tree. The tree is now of wide distribution in Sudan, where the summer temperature is very high. The tree is evergreen, but continue to shed large amounts of leaf litter throughout the year. Mesquite (*P. juliflora*) on the other hand, was reported to contain antimicrobial compounds (Zainal *et al*., 1988). Although many studies have examined the viability of bacteria on fabrics (McNeil and Greentein, 1961, McNeil, 1964 and Sattar *et al*., 2000), nothing was made on fabrics treated with natural antimicrobial substances.

The present study therefore, investigated the survival of S. *aureus* and *E. coli* , on fabrics treated with extracts obtained from mesquite plants (*P. julifora*).

## MATERIALS AND METHODS

### Bacterial growth and inoculum preparation:

Bacterial isolates of *E. coli* and *Staphylococcus aureus* were obtained from the Food Microbiology Laboratory, and grown in nutrient agar medium(NA).

A 48 hours old culture of both *E. coli* and *S. aureus*, on plates containing a NA medium were used for the preparation of the inoculums. The growth was covered with 10 ml sterile distilled water and was scraped by a sterile inoculating needle and mixed well with water. The bacterial suspension was poured into 250 ml flask and completed to 100 ml.

### Preparation of plant extracts:

Plant parts of mesguite (*Prosopuis julifora*) collected from fields around the University of Gezira, main compus, Wad Medani, were allowed to dry in the Food Microbiology laboratory, Faculty of Engineering and Technology. The dried material was crushed into powder using a crusher device. Samples of 10 grams each were weighed from the powdered material, added to 100 ml solution of caustic soda (40 grams of caustic soda in 360 ml distilled water), mixed well with steering and left to cool at room temperature (28 – $30^0$ C). The solution was filtered through a Watsman No l. 1 filter paper and the filtrate was kept in the refrigerator ($4^0$ C) before being used for impregnation of the fabrics.

### Effects on bacterial growth

Five ml of the bacterial suspension prepared as above were added to a flask containing nutrient agar (NA) medium. Control flasks received only 5 ml of sterile distilled water. The medium in each flask was then poured in sterile Petri dishes and allowed to solidify at room temperature. After 24 hours, filter paper discs containing different concentrations of the above prepared plant extracts, were placed centrally, each

in one plate, on the medium surface, the inhibition zone was measured daily (Zainal, et al., 1988).

**Effects of the extracts on bacterial survival on fabrics**

**Preparation of fabrics:-**

Grey cotton fabrics were purchased from local market, washed with a solution of caustic soda and a detergent at $90^0$C for one hour, then rinsed thoroughly with water and left to dry at room temperature. A laundry process was carried out to remove shrinkage and to ensure dryness. When treated with iodine the starch was found to be removed completely from the fabrics. The absorbency of the fabrics was also found good. The fabrics were then cut into equal pieces (20 X 20 cm), which were impregnated in the plant extracts prepared as described above. Impregnated fabrics were allowed to dry and then kept before being inoculated with bacterial suspensions.

Each fabric piece, impregnated with a plant extract (three per treatment) was immersed in the bacterial suspension prepared as above and allowed to stand there for 6 hours. Inoculated fabrics were then removed and allowed to dry without squeezing or any other treatment. After dryness the survival of the bacterial cells in those fabrics (containing plant extracts) was assessed every 2 weeks, for a period of 12 weeks.

**Bacterial Enumeration**

Every 2 weeks 10 grams of the impregnated and inoculated fabrics were removed, cut into very small pieces and one gram was taken, dipped into 10 ml sterile distilled water and well macerated. Serial dilutions were made and 0.1 ml was put onto the surface of the solidified NA medium in Petri dishes and the sample was spread with a glass red throughout the surface of the medium. The plates were then incubated at $37^0$ C for 48 Hours and the number of the bacterial colonies appeared, were calculated per one gram of fabrics. Three replicates were used for each treatment.

## RESULTS AND DISCUSSION

It was reported that many cases of infection can take place from contact with contaminated materials in hospitals (Lamanna and Mallette, 1965). According to Lee *et al*. (1969) *Salmonella typhimurum* can remain viable and infectious on different types of fabrics for relatively long periods of time, although against such contamination, plant extracts were found better. Plant extracts have been suggested as alternative to anti-microbial agents, since antibiotics often lead to the development of resistance.

The effects of plant extracts of mesquite on growth and survival of two bacteria on cotton fabrics were investigated in the present study. Results in Table (1), show that the aqueous extracts of mesquite clearly inhibited growth of the Gram–positive bacterium, *S. aureus*. However, the inhibition zones are absolutely clear. On the other hand, extracts of mesquite are less effective against growth of the Gram-negative bacterium, *E. coli* (Table, 1). Zones of inhibition indicated that plant extracts are more effective against Gram –positive bacteria. Zainal *et al. (*1988) also reported a pronounced effect of the leaf litter extracts of mesquite on different microorganisms. There are many reports, in the literature, about the presence of anti-microbial substances in plants (Harrison, 1971; Dix, 1979 and Abdel - Rahim *et al*., 2002).

Mesquite plants is more effective when extracts of the leaves are used compared to the other plant parts. It was already found that the antimicrobial activity in plants may depend on the stage of growth or may be an organ dependent (Stephen *et al*., 2004).

Table 1. Inhibition zone (mm) of growth of *S. aureus* and *E. coli* on leaf extracts of mesquite (*P. Juliflora*).

| Extract Concentration % | Zone (mm) of *E. coli* | Zone (mm) *S. aureus* |
|---|---|---|

| | | |
|---|---|---|
| 0.5 | 10.2 | 12.0 |
| 0.1 | 9.50 | 10.3 |
| 0.05 | 8.20 | 10.0 |
| 0.01 | 5.40 | 9.0 |
| 0.001 | 5.0 | 8.0 |
| 0.00 | 0.00 | 0.00 |

Table 2. Effect of extracts from different plant parts of mesquite on growth of both, S. *aureus* and *E. coli*

| Plant parts | Inhabition Zone(mm) | |
|---|---|---|
| | *S. aureus* | *E. coli* |
| Leaves | 12.2 | 10.5 |
| Stems | 9.8 | 8.5 |
| Pod | 7.7 | 5.0 |
| Seed | 5.5 | 4.1 |

Results in Table (2) show that, the antimicrobial effect of the mesquite plants is more effective when extracts of the leaves are used compared to the other plant parts. It was already found that the antimicrobial activity in plants may depend on the stage of growth or may be an organ dependent (Stephen et al., 2004).

The present study also investigated the effect of the extracts of mesquite leaves on the survival of the two bacteria on cotton fabrics. Results on Fig. (1) Show that the number of cells of the Gram positive bacterium, *S.aureus* decreased continuously with the incubation time and they persisted for only 8 weeks in the cotton fabrics impregnated with mesquite leaf extracts. On the other hand, cells of the Gram negative bacterium, *E. coli* were less affected and able to persist for 10 weeks on fabrics impregnated with mesquite extracts, although its number was decreasing gradually (Fig. 2). This was in agreement with our results mentioned above. It was also agreed with the results of Zainal *et al*. (1988), who mentioned that plant extracts of mesquite are bactericidal against

Gram-positive bacteria more than to the Gram-negative ones. According to Sattar *et al.* (2001), that the critical aspect of a bacterium transmission from one person to another in a hospital, is its ability to survive on various common hospital materials such as fabrics. Therefore, fabrics treated with antimicrobial agents, are gaining popularity as a new promising area of research.

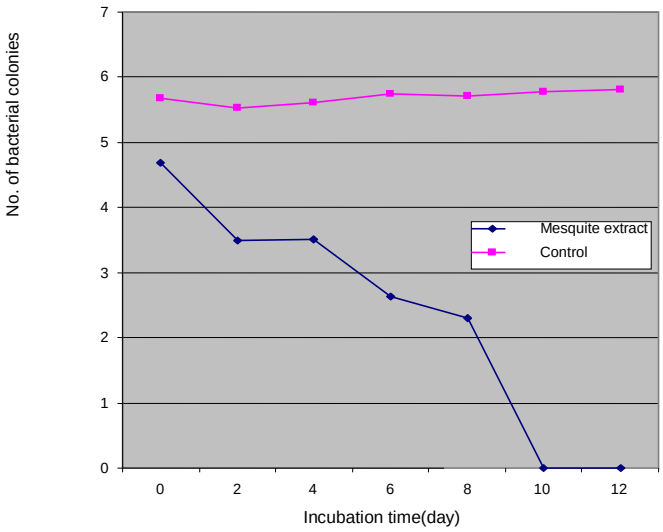


Fig.1. Survival of *S. aureus* on cotton fabrics treated with mesquite extracts

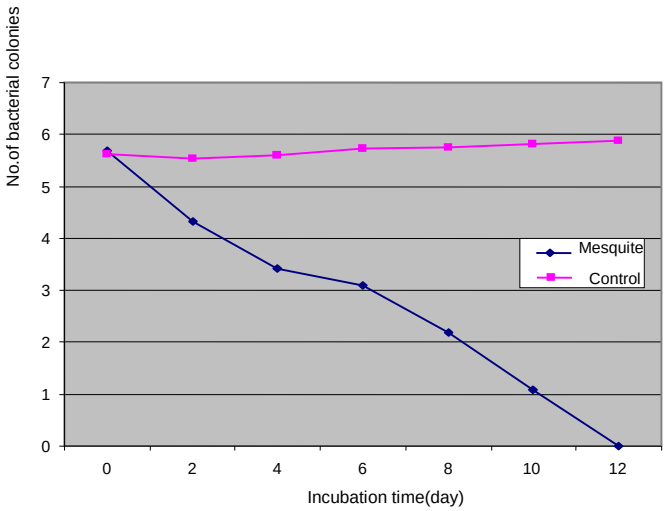


Fig. 2. Survival of *E. coli* on cotton fabrics treated with mesquite extracts

## CONCLUSIONS

From the present study, it could be concluded that mesquite extracts are able to inhibit growth and reduce the survival of the Gram positive bacteria on cotton fabrics and can, therefore, be used as an alternative to antibiotics, since antibiotic resistant strains of the Gram positive bacteria have already been reported (Kim et al.1998 and Neely and Maley, 2000). However, plant extracts were found effective and used against microorganism since the beginning of the human civilization (Gilliver, 1947; and Dix, 1988). Mesquite (*P. juliflora*) was reported by many investigators (Federie and Vestal, 1982 and zainal et al; 1988), to contain antimicrobial compounds eg. Gallic acid.

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# نمو وبقاء بعض الأحياء الدقيقة على المنسوجات القطنية المعاملة بمستخلصات نبات المسكيت (*Prosopis juliflora*)

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## الخلاصة

بحثت هذه الدراسة تأثير مستخلصات نبات المسكيت المائية علي نمو وبقاء اثنين من البكتيريا (*S. Aureus* و *E. coli*). أوضحت النتائج أن المستخلصات المائية لأجزاء نبات المسكيت المختلفة لها تأثير عالي في تثبيط النمو البكتيري. هذا وقد كان التأثير أكثر فعالية علي البكتيريا الموجبة لصيغة جرام (*S. Aureus*)، مقارنة بالبكتيريا السالبة لصيغة جرام (*E. coli*). وكانت مستخلصات المسكيت أيضاً ذات فعالية في أضعاف قدرة البكتيريا علي البقاء في المنسوجات القطنية وكان التأثير كذلك أكثر فعالية علي البكتيريا (*S. Aureus*) الموجبة لصيغة جرام.